U.S. Department of Energy

Office of Electric Transmission and Distribution

Energy Storage Program

Plugging America Into the Future of Power

Overview

It is DOE's vision that advanced energy storage systems will be fully integrated with advanced power electronic controllers on the nation's transmission and distribution networks, thereby ensuring reliable delivery of electricity at levels of power quality sufficient to meet the stringent consumer needs in the digital economy. Advanced energy storage systems will be integrated with distributed energy resources and renewables to provide optimum market value to the producer and user.

The Energy Storage Program performs research and development for storage technologies and systems that incorporate a broad technology base consisting of batteries (both conventional and advanced), flywheels, high-energy-density capacitors, superconducting magnetic energy storage (SMES), power electronics, and control systems.

The Energy Storage Program also works closely with industry partners, and many of its projects are cost-shared. The Program's partners include battery, power electronics, and storage system manufacturers; utilities and independent power producers; and national and international research organizations.

Energy storage has a number of major application areas, which differ by their power and energy requirements. Enhanced energy storage can provide multiple benefits to both the power industry and its customers, among them:

- Improved power quality and reliable delivery of electricity for customers;
- Improved stability and reliability of transmission and distribution systems;
- Increased use of existing equipment, deferring or eliminating costly upgrades;
- Improved availability and market value of distributed generation sources.

Program Areas

System Integration

System integration pursues a strategy to reduce the costly, labor-intensive, and error-prone assembly and debugging of individual components in the field which were traditionally required when utility energy storage systems were designed and built. The major storage system components (storage device, power electronics, control system, AC connection) are designed as interfacing modules so that integration can occur either at the factory or seamlessly at the customer site.

System Evaluation

System evaluation involves data collection and analysis from existing systems. This effort documents the technical and economic performance of systems, yields quantitative cost/benefit evaluations, identifies areas in which further research should be focused, and provides lessons learned for future projects.

Component Research and Development

Component R&D focuses on advancing the technologies of the individual components that make up a system. Development of advanced storage devices (flywheels, high-energy-density capacitors, advanced batteries), associated power electronics, intelligent control systems, and component testing provides a base for future energy storage systems.

Research and Analysis

Research and analysis applies analytical methodologies to identify utility and customer requirements and to estimate the technical and economic benefits of energy storage. Efforts undertaken in this area help position the program to respond to the emerging needs of the restructured electricity marketplace.

Mission

To develop advanced energy storage systems in partnership with industry to:

- *Minimize costs incurred from power quality and reliability problems;*
- *Increase technology choices in deregulated, competitive electricity markets;*
- *Increase the value of renewable and distributed resources .*

Program Areas

The Energy Storage Program's Energy Storage Systems Research Program is organized in four areas.

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Construction at the Regenesys Energy Storage Plant

Success Story

Regenesys Energy Storage System Installation at the Tenessee Valley Authority

The Energy Storage Program is working with Electrotek Concepts to conduct a performance assessment of a large-scale energy storage plant being built by the Tennessee Valley Authority (TVA), the Regenesys Energy Storage plant near Columbus Air Force Base, Mississippi, which TVA is building in partnership with Regenesys Technologies Ltd., AMEC Inc., and Day Zimmerman NPS.

The Regenesys plant will store electricity generated during off-peak periods for use when the need for power increases. The plant can store up to 120 MWh of energy and provide power for 10 hours or more to some 7,500 homes. During periods of low demand for electricity, the plant is "charged" by a chemical process using power generated by other plants. The process is then reversed to transmit electricity stored at the plant when the demand for power rises. Stored energy can provide a reliable, uninterruptible power source; improve power quality and reliability; and allow TVA to take advantage of daily load cycles. It can also improve utilization of power plants that are currently cycled on and off to meet fluctuations in demand. Readily available, stored electric power can provide voltage support, frequency regulation, and rapid response to power demand.

The project will cost in excess of $25 million. Construction began in October 2001 and is on schedule for mechanical completion by April 2003. The Regenesys plant is targeted to be operational in late 2004.

The team will evaluate the data acquisition system for the plant and will provide management of collected data and technical and economic analysis of the facility's performance. The goal of the project is to gain a comprehensive look at the plant's operation and its performance under varying operating and load conditions.

Cell Piping at Regenesys.

Electrolyte storage tanks at Regenesys.